Report of the Third NASA LBA-Ecology Science Team Meeting
Belem, Brazil
19-21 April 1999

June 14, 1999

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Table of Contents

1.0 Introduction

The third science team meeting of the LBA-Ecology project was held at the Hilton Hotel in Belem, Para, Brazil on April 19-21, 1999. LBA-Ecology research groups were well-represented at the meeting. A total of 125 scientists and project staff registered at the meeting with 61 participants from Brazilian institutions, 58 from the US, and 6 from Europe. The purpose of the third science team meeting was to finalize the planning of field work, coordinate field activities with modeling activities, and to organize our science team for research activities. A fourth full science team meeting should be held during the period April-June 2000 in order to discuss preliminary results. The program of the meeting which covered 2.5 days was mainly devoted to small group meetings of science team participants. The meeting agenda is attached in Appendix 1.

On the morning of April 19, the group met in plenary session for a series of introductory talks regarding the status of the LBA program. Dr. Michael Keller, LBA-Ecology Project Scientist, Dr. Diane Wickland, NASA Terrestrial Ecology Program Manager, Dr. Iara Weissberg, LBA Officer, and Dr. Adilson Serrão, General Director of EMBRAPA Amazonia Oriental presented brief statements. David Hodge, of the US Embassy joined Dr. Weissberg to discuss the LBA- Ecology Implementing Arrangement. A copy of this document can be found on the web <http://lba-ecology.gsfc.nasa.gov/lbaeco/News_Events/latestnews.htm>. Following these programmatic introductions four speakers presented updates on the progress of allied LBA science programs. Dr. Paulo Artaxo of the Universidade de São Paulo (USP) presented an update on LBA atmospheric chemistry activities. Dr. Maria Assuncão Silva-Dias (USP) presented a summary of the recent LBA Atmospheric Mesoscale Campaign in Rondonia. Dr. Pavel Kabat gave an overview of the various European activities in LBA and Dr. Roni Avissar introduced the group to the recently initiated LBA-Hydrometeorology project <http://maximus.ce.washington.edu/~tempcm/lba.html>. Dr. Donald Deering, Project Manager and project office staff including Dr. Stefan Sandmeier, Dan Hodkinson, Lisa Zweede, Merilyn Gentry, and Janice Wiles provided updates on support activities including logistics, infrastructure, data information systems (DIS) and education and outreach activities.

Additional reports of Science Team activities were presented on Tuesday morning, April 20. These reports covered the activities of the Science Team including the regional productivity modeling workshop <http://lba-ecology.gsfc.nasa.gov/lbaeco/Investigator_Exchange/Workshops/workshops.htm>, the Santarém site selection activity <http://lba-ecology.gsfc.nasa.gov/lbaeco/Investigator_Exchange/infrastructure.htm>, the secondary forest workshop <http://lba-ecology.gsfc.nasa.gov/lbaeco/Investigator_Exchange/Workshops/workshops.htm>, and the remote sensing workshop. Reports of these activities are available from our web site as indicated or will soon be published there.

As indicated in the agenda (Appendix 1) the group was fortunate to receive 5 brief science talks highlighting work being conducted by scientists based in Belem, Drs. Adilson Serrão, Tatiana Sá, F.Assis Oliveira, PauloMoutinho, Ima Celia Vieira, and Natalino Silva.

Working Groups

The group reports and appendices that follow compile the results of the meeting. One set, the site-based groups (including region-wide) dealt with the primary themes of the meeting. Special topics groups dealt with policy issues and follow-up to various workshops. The policy related issues (Long Topics) are reported on below. There are no reports for the short topics; a report of the canopy group prepared prior to the meeting will soon be on the LBA-Ecology web site.

2.0 Site Base Discussions

2.1 Acre Site (Discussion leaders - Foster Brown and Eufran Amaral)

<u>Current Activities</u>

The following LBA projects are involved in the Acre Site:

1. *Land-Cover/Land-Use Change in an Expanding Frontier in Western Amazonia:* Acre, Brazil (LC-02)
2. *Biogeochemical Cycles in Degraded Lands* (ND-02)
3. *Radar Remote Sensing of Land-Cover and Biomass in the Amazon* (LC-03)
4. *The Present and Future Effects of Ground Fires on Forest Carbon Stocks, Metabolism, Hydrology, and Economic Value in Amazonia and Cerrado* (CD-05)
5. *Carbon Dynamics in Vegetation and Soils Along the Eastern LBA Transect* (CD-08)
6. *Carbon and Nutrient Stocks, Soil Water Dynamics, and Trace Gas Fluxes in Abandoned Pastures and Agroforestry Systems in the Central Amazon* (ND-04)

Several Brazilian and Peruvian students and young researchers based in Acre are conducting research in these projects: Elsa Mendoza (4, 1, 5); Antonio Willian de Mello (2,1); Cleber Salimon (2,3,1), Silvia Brilhante (1); Andrea Alechandre (1); Eufran do Amaral (1,2); Henrique Sant'Ana (1); Hiromi Sassagawa (1).

Field measurements have already begun for secondary forest biomass and for burning histories (projects 1 and 4). Project 2 will begin carbon dioxide flux measurements in the field this May. Project 5 will begin collection of material for isotopic dating in July. Project 3 will visit field sites in September.

Temperature, soil water, litter fall, and fire susceptibility data are being collected at 14-day intervals during the dry season at the Catuaba field area, 30 km east of Rio Branco. Landsat TM imagery for 1986, 1992, and 1998 are being analyzed for land-cover evolution in the Chico Mendes Extractive Reserve.

<u>Infrastructure, Logistics, and Operational Issues</u>

Currently, the Zoobotanical Park of the Federal University of Acre (PZ/UFAC) serves as the primary base of activities for projects 1,2,3,4, and 5. The Center for Agroforestry Research of Embrapa in Acre (CPAF/Embrapa Acre) is the primary base for project 6 and helps support projects 1 and 2.

To satisfy demand for space and reduce costs that would be incurred by renting additional laboratory space will be provided at the PZ/UFAC via financial support from NASA LBA-Ecology.

NASA LBA-Ecology will also provide a Toyota double cabin 4 x 4 pickup for local transportation.

Proposed Organization

Elsa Mendoza (seletro@mdnet.com.br), Antonio Willian de Mello (willian@cpafac.embrapa.br), and Foster Brown (fbrown@mdnet.com.br) will act as site managers for Acre and coordinate activities.

2.2 Brasilia Site (Discussion leader - Richard Zepp)

A variety of measurements will be collected in the cerrado outside of Brasilia in two main ecosystems the cerrado stricto senso and campo sujo located on the IGBE reserve. Land uses will include recently burned, a control (not recently burned) as well as some studies in the IGBE rainfall exclusion plots.

Current Activities

The research groups involved at the Brasilia site include:

1. *Biogeochemical Cycles in Degraded Lands* (ND-02)
2. *Radar remote sensing of landcover and biomass in the Amazon* (LC-03)
3. INOC-DC (SAVAFLUX)
4. *Influence of Amazonian land-use change on chemical constituents in the atmosphere* (TG-02)
5. *Characterization of aerosal optical properties ans column water vapor for LBA-Ecology* (TG-03)
6. *The present and future effects of ground fires on forest carbon stocks, metabolism, hydrology and economic value in Amazonia and Cerrado.* (CD-05)
7. *Impacts of deforestation on carbon and nutrient cycles and trace gas exchange in Amazonian soils.* (ND-07)

Infrastructure, Logistics, and Operational Issues

Basic logistical requirements for each group consist of transportation for equipment and personnel and approximately 3 meters of lab space each for various analysis. There is also a need for some office space and web access. A Toyota truck has been delivered from Rondonia. Currently, it is registered as an embassy vehicle and Antonio Miranda "accepted" it upon arrival at the university.

Proposed Organization

Heloisa Miranda will serve as local logistics coordinator for Brasilia. Mercerdes Bustamante will be the assistant coordinator and Jair Maia was hired May 1st through the LBA-Ecology Project office as the site assistant. Heloisa Miranda, Richard Zepp, John Grace and Dan Nepstad will serve as an advisory panel to sort out questions and conflicts for the Brasilia site. This panel will not advise on changes of scope.

Michael Keller questioned how this organizational structure is going to function. Also, is there a vision of how this site will be scaled up and incorporated into the regional analysis?

2.3 Manaus Site (Discussion Leaders - Erick Fernandes and Rita Mesquita)

Current Activities

The following LBA projects are involved in the Manaus Site:

1. *Radar Remote Sensing of Land-Cover and Biomass in the Amazon.* (LC-03)
2. *Carbon Dynamics in Vegetation and Soils Along the Eastern LBA Transect.* (CD-08)
3. *Carbon and Nutrient Stocks, Soil Water Dynamics, and Trace Gas Fluxes in Abandoned Pastures and Agroforestry Systems in the Central Amazon.* (ND-04)
4. *Influence of Amazonian land-use change on chemical constituents in the atmosphere.* (TG-02)
5. *Anthropogenic landscape changes and the dynamics of Amazonian forest biomass.* (LC-05)
6. *Carbon and oxygen isotope ratio CO2 flux analysis at the soil, canopy, and landscape scales.* (CD-02)

The Smithsonian Forest Fragments Project will be conducting measurements of tree biomass and forest dynamics (rates of tree mortality, damage, growth, and recruitment) in 69 permanent 1-ha plots at the ZF3 site and the Fazenda Dimona. Thirty-three plots are in continuous forest while 36 plots are in 9 forest fragments ranging from 1-100 ha in area. Each 1-ha plot will be measured once over the next 2.5 years. These data will be used to augment long-term (up to 19-year) studies of forest biomass and dynamics in each plot. DBH measurements will be converted to estimates of above-ground biomass using allometric models. Biomass estimates for small (<10 cm DBH) trees, lianas, vines, forbs, leaf litter, and coarse and fine woody debris will be collected in a stratified subset of 20-30 1-ha plots.

Thirty 0.09 ha permanent plots will be established in regrowth chronosequences. Within each plot, sizes of all stems $\geq$1 cm DBH will be measured once per year for the next 3 years to estimate growth rates and above-ground biomass. Floristics data will be collected on all stems $\geq$1 cm. Destructive and non-destructive methods will be used to estimate understory (forbs, vines, etc.) and tree biomass.

The Cornell University – EMBRAPA-University of Amazonas project (ND-05) will evaluate nutrient cycling and resource capture at the KM 54 base site along BR 174 (Distrito Agropecuario da Suframa). Four agroforestry systems that were established on abandoned pasture land in 1991 will be systematically evaluated for above and belowground C and nutrient stocks, rooting depth and fine root turnover, litter decomposition, secondary species succession, soil macrofauna dynamics, and aboveground biodiversity. The 4 systems will be compared against abandoned pasture vegetation control plots. Each of the systems and control plots occupy 3,000 m^2 in a randomized block design with 3 replicates. Aboveground biomass will be estimated using destructive harvests and allometric equations. Nutrient and C stocks in vegetation and soil will be determined through destructive harvest, and tissue and soil analysis. A Bartz minirhizotron with digital video capture will be used to track fine root dynamics.

Resource capture will be evaluated through the characterization of light environment

(LAI), monitoring of the light interception by vegetation (fish-eye image canopy analysis of LAI) and measurement of the soil water content (TDR). Continuous collection of basic environmental parameters, such as total incoming solar, PAR, air temp, soil temp, rainfall, RH, wind speed and wind direction will be made using a weather station from Campbell Scientific or other compatible components. Soil water content will be measured at 20-cm intervals to a depth of 2 m bi-weekly during the rainy season, and weekly during the dry season. Ninety to 100 access wells are planned for the Trime TDR well access probes. Monthly measurements to depth >3 m may also be taken with a Didicott Neutron Probe.

Stable isotope ratios of atmospheric CO2 will be calculated during the wet and the dry season at the ZF2 site to infer changes in terrestrial ecosystem photosynthesis and respiration (CD-02). The measurements will include carbon and water flux related measurements of leaf photosynthesis, leaf nitrogen content, soil water content, leaf water potential, understory eddy variance measurements, and air and soil CO2 efflux and profile measurements. Measurements of organic carbon and tree ring measurements will be conducted to evaluate carbon stocks.

Tree diameter increments and wood production will be determined using dendrometer bands (measured monthly) on 400+ trees at the ZF-2 site (CD-08). The data in conjunction with daily precipitation measurements will be used to establish a moisture growth relationship. Dead wood respiration will be measured during the dry season and the wet season using an IRGA LICOR to determine moisture flux relationships. Tree ages determined using radiocarbon techniques will be used to compare campinarana and primary forest. Tree mortality rates will be used to evaluate the spatial variability in dead wood production. Tree growth rates (30 year averages) will be determined using bomb radiocarbon tracer techniques

VOC measurements (including isoprene, monoterpenes, oxidation products, and possibly oxygenated compounds such as MeOH, acetone, etc.) are planned for 1-2 weeks during the wet season 2000 (TG-02). These measurements will incorporate a variety of sampling platforms; tower(s) for gradient REA samples, tethered balloon profile sampling, and leaf/branch measurements. Mixed layer averages of CO2 may be sampled from the tethered balloon as well as characterization of boundary layer height, turbulence and RH profiles. Ozone profile measurements or integrated column measures may also be taken.

Field validation of land cover class with a mobile GPS and base station is planned for 2 weeks in August 1999 (LC-03). Aboveground biomass will be determined in August 2000 using tree counts, diameter, and tree height. Validation of land cover and biomass is planned again for August 2001 using the same tools as above.

Infrastructure, Logistics, and Operational issues

Each of the 3 main field sites in Manaus need help with infrastructure and maintenance.

The EMBRAPA station, at BR-174 km 51 needs electrical systems maintenance and an electrical generator as well as an upgrade of communication systems (e-mail, radio, telephone) and facilities for sample preparation and storage on site (oven, soil and plant grinders). There is also a special need to establish site security to protect personnel and equipment.

The INPA-Smithsonian Colosso Camp, at ZF3 km 24, needs a generator with lights and power points (wiring), a stable power supply and computer surge protector, a water pump with service to install it, and communications and road maintenance (~5 km).

The tower and camp at ZF2 requires road and site maintenance, living and field facilities (trails, security), various lab expendables, a generator, and updated communications (radio maintenance, walkie talkies; $5-6K per year).

Dobson /Soares while in Manaus (1-2 weeks in 2000 and again in 2001) need a mobile GPS and field station comprised of transport and lodging for 3 people with limited lab and office space.

Proposed Organization

The Manaus Group discussed its local organization, and felt strongly that it should be non-bureaucratic. All members are easily reached via e-mail, including a connection with the European partners of LBA. An email list for the Manaus LBA-Ecology personnel is currently in operation. A local steering committee was formed to supervise the implementation of the local LBA-Ecology program and to facilitate linkages between LBA, local institutions, and among the LBA research projects. The committee includes two Manaus-based representatives (Elisa Wandeli and Rita Mesquita), with two external members (Luis Martinelli and Erick Fernandes). Niro Higuchi, of INPA, was elected *in absentia* by the committee as the local chair. This Committee will be used to guide both policy and to resolve practical issues such as study site logistics, potential collaborations, and opportunities for LBA participants to get involved in local teaching and training activities.

Research Needs

Current local government discussions on development and settlement plans for the Distrito Agropecuário da Suframa warrant our attention. There is a possibility of further development in second-growth areas where the pasture chronosequence sites are located especially around the Smithsonian Forest Fragments area. Any settlements in these areas would severely compromise the proposed experiments. The Steering Committee will establish contacts with local government agencies to inform them about the LBA-Ecology program and experiment sites.

2.4 Santarem Site (Discussion Leaders - Daniel Nepstad and Osvaldo Moraes)

The area around Santarem is rapidly changing as the road is developed and soybeans are starting to be shipped from the city. The geographical location of Santarem has placed it in the center of many of the impacts of El Niño and fire.

Current Activities

Science team activities in Santarem are beginning relatively slowly as several investigations are awaiting the installation of infrastructure in the area. Air and vegetation sampling for isotopic analysis has begun in the FLONA Tapajos and in surrounding areas (CD-02). Biogeochemical and nutrient cycling studies (TG-07) have begun on representative sand and clay soil sites in the FLONA Tapajos. The Seca-Floresta Project is collecting data at km 67 in the FLONA Tapajos prior to an experimental dry-down of 1 ha. Seca-Floresta is not formally an LBA project although many of the scientists involved are also working in LBA-Ecology. Currently, we are investigating the possibility that Seca-Floresta will join LBA-Ecology.

Infrastructure, Logistics, and Operational Issues

The entrance to the Santarem site at km 67 will be along a boardwalk leading to access to the main trails. This boardwalk is to be maintained by the LBA-Ecology Project office. Dan Nepstad and his team will develop a base grid with coordinates and trail posts. The specific grid system remains to be determined. Bill Munger will develop a site map and keep it up to date. The LBA-Ecology Project office is currently soliciting bids for a contract for construction of a base camp at km 84. A house in Santarem will be modified by the Project office to serve as a lab and offices.

Vehicles will be assigned on a first-come first-serve basis. Scheduling conflicts will be resolved among the teams themselves. It is possible that vehicles will be assigned to each area (km 67, km 84, pasture). A maintenance calendar will be developed and maintained by the Santarem LBA-Ecology office (Lisa Zweede). Each site should have a satellite phone. There should also be a vehicle at each site when someone is working there. Safety education should be provided by the Santarem LBA-Ecology office. In general, researchers should avoid working alone. Team leaders need to take responsibility to discuss safety issues with their teams. Safety protocol for the towers will be defined by the Santarem LBA-Ecology office. This may include the development of a tower safety course. Snake bites may be avoided by wearing high top shoes and paying attention to where you step. Anti-venoms should be kept at a location where they can be safely stored and safely administered. It may be preferable to have only trained medical personnel administer anti-venom because of the risk of shock.

Proposed Organization

Bill Munger has volunteered to serve as site coordinator. He will be responsible for compiling the information about the location, type, and time measurements will be taken. Permissions for measurements beyond the initial plan will be authorized by Bill Munger. Vehicle maintenance and local logistics will be coordinated by Lisa Zweede. Gladys Martinez will serve as the EMBRAPA liason.

Michael Keller questioned what happens when Bill Munger is unavailable?

Research Needs

The knowledge of the actual extent of areas burned and logged is missing from all of LBA-Ecology. Gaps in planned studies of specific interest to scientists in the Santarem study include a lack of vegetation information at the species level and LAI measurements around the planned towers. Additional allometric information may be useful particularly for large trees. Information on the extent and effects of logging in the local area is also needed. Additional information is needed to fully develop the calculations of NPP. Measurements of fine litter production and leaf-level photosynthesis in the pasture, and tree dendrometer bands in the logged forest should be added. Permanent plots must be established to study stand dynamics. Lignin and chlorophyll measurements are needed for leaf chemistry analysis. It is possible that Claudio Carvalho will develop some of the leaf chemistry work. Soil solution chemistry is lacking in the pastures. Measurements of solar transmission with sun photometers and a network of approximately 25 tipping bucket rain gauges and inexpensive PAR sensors in gaps and around the towers will enhance the accuracy of atmospheric measurements to aid in attempts at regional modeling.

2.5 Rondonia (Discussion Leaders - Linda Deegan and Marcos Pedlowski)

Current Activities

The research groups involved at the Rondonia site include:
1. *Biogeochemical dynamics in river corridors of the Amazon basin and their response to anthropogenic change.* (ND-09)
2. *Linking soil biogeochemistry to surface water chmistry in small drainage basins of the Amazon.* (ND-03)
3. *Land cover conversion in Amazonia, the role of environment and substrate composition in modifying nutrient cycling and forest regengeration.* (ND-01)
4. *Measurement and modeling of the inter-annual dynamics of deforestation and regrowth in the Brazilian Amazon: Land use control on the annual net flux of carbon.* (LC-10)
5. *Trace gas fluxes associated with land-cover and land-use changes in the Brazilian Amazon Basin.* (TG-08)
6. *Radar remote sensing of landcover ans biomass in the Amazon.* (LC-03)

Infrastructure, Logistics, and Operational Issues

As a primary measure, the Group decided that infrastructure and all available common resources should be allocated according to the concept of "FIRST REQUESTED, FIRST SERVED." The Operations Committee (OC) will be responsible to handle possible conflicts over resource utilization when researchers can not reach an agreement on their own. However, the actual implementation of operational decisions will remain in charge of the local person hired by NASA. We anticipate the greatest demand for vehicles will be in the dry season (July-Sept).

In order to allow enough time for people to register for the use of common resources, the Group decided that registration should be made six weeks ahead of time. This early registration should to permit all interested parties a fair chance to gain access to the resources. Those that did not register will be able to use the resources if the registered party is not using the item.

The Group also agreed that an email list for all researchers working in Rondônia should be put in place to allow a steady communication process among the different teams working in the state. Steady communication will be a key element to preventing conflicts in the field.

DEADLINES FOR THE REQUEST OF COMMON RESOURCES UTILIZATION IN RONDÔNIA

Deadlines For Registration	Months
November 15	January through March
February 15	April through June
May 15	July through September
August 15	October through December

Proposed Organization

The Rondônia Group also discussed the potential role for an Operations Committee (OC) in overseeing the implementation of LBA-Ecology. This Committee will be used to guide both policy and to resolve practical issues such as scheduling during the implementation of LBA in Rondônia. Three members were chosen to participate in the Rondônia OC: Alex Krusche, Marcos Pedlowski and Oliver Chadwick.

Pavel Kabat questioned how the group will coordinate with Europe. Should they have the same site coordinator Joao Luiz Esteves of INCRA?

State Level Data Sources in Rondonia

A representative of the Rondônia government (Eraldo Matricardi) presented information on the Agro-Ecological Zoning of Rondônia. The Group (6 out of 11 projects represented) expressed interest in having access to different databases created during these studies. Eraldo Matricardi indicated that it would be possible to send a copy of the material to the LBA Office at CPTEC. There was a consensus among the participants that a dynamic process of data sharing should also be created by LBA-Ecology to allow a steady transfer of information from the program to State agencies working in Rondônia. The LBA Central Office has initiated the contacts to implement this agreement.

2.6 Amazon Region (Discussion leaders: Jeffrey Richey and Maria Assuncao Silva Dias)

Regionalization – What are the Issues and the Solutions?

A significant portion of the research effort in LBA-Ecology is focused on site-specific measurements -- i.e. focused on towers and local plot-level studies. The problem for this discussion group was, how can these measurements be extrapolated regionally? Elsewhere in LBA there are projects dealing with the Amazon basin as a whole. How can these projects be interpolated regionally? The issue of scaling and regionalization are not new. What is now required, however, is a robust strategy that recognizes the reality of the Science Team now in place, where specific projects are distributed in the basin and the scale they are working at, and the resources available.

A set of terms of reference were established for the group:

1. Given the predominance of site-specific studies, the discussion focused on scaling up to regions (rather than down-scaling-per se).
2. The focus must be on the intensively-studied regions of LBA-Ecology (Santarem, Rondônia, Manaus, greater Belém).
3. The perspective is from land surface dynamics (not the atmosphere per se).
4. The issues or topics to be considered at the regional scale include a set of system attributes (not just, for example CO_2):

- Carbon fluxes via NPP, NEP (to address core LBA issues)
- Nutrient dynamics (including land/river interface chemistry and transport)
- Moisture fluxes - ET, SM, and river discharge (to improve analyses of moisture constraints on carbon and nutrient dynamics
- Ecosystem structure
- Assessment of human impacts

5. Recognition that honest appraisal of space (meters to hundreds of kilometers) and time scales (minutes to decades) is fundamental. What is “expected” at regional scales is not just “smaller” or “bigger” pixels, but actual expression of processes and structures at that scale, capable of identifying significant non-linear phenomena.

6. The importance of episodes was recognized; this is not just an averaging issue, but one of potentially missing key events. Rainfall is an example. Another is pulse of trace gases when lake and river levels fall rapidly.

7. Overall, What are the tradeoffs in precision and reality – what is feasible? Given that conclusion, what is the “best” that can be done?

In light of these basic issues, the strategy evaluated in the discussion was to seek convergence of four areas of research:

- *Modeling* from both land surface and atmosphere synthesis perspectives; (preferably with models of at least moderately different heritages),
- *Regionalization of high resolution ground data* of soils (texture, chemistry), vegetation biomass and structure, and topography
- *Direct assessment of land surface change* via remote sensing in response to changes in forcing functions,
- *Validation* by direct measurements of regional-scale fluxes - from isotopes to light aircraft

to river discharge.

Based on these discussions, the following action items and decisions were recommended:

1. Focus on scaling up to the dominant regions of LBA - Brasilia, Manaus, Santarém, Rondônia, Belém/Bragantina, and Acre. While discussions remain, the "regional" areas will be defined by the drainage basins covering the respective areas at a 1 km scale
2. Set a structure in place that includes a common data structure, nomenclature, model structure and spatial scale.
3. Strategy: combined modeling, regional ground data, targeted remote sensing.
4. Rondônia Scaling Experiment – The NASA/TRMM-LBA wet season atmospheric mesoscale campaign (WETAMC - Jan and Feb, 1999) may provide a framework for combining models and remote sensing data (including radar derived rainfall with 1 km resolution).
5. Santarem Integrating Experiment – In an intensive campaign mode, when towers and aircraft sampling are already in place, launch radiosondes in a couple of points and several per day, to provide the means to integrate the tower data with the aircraft. Ideally dry and wet season should be a focus of intensive campaigns.
6. Groups make public their surface moisture variables at 10 day resolution
7. Validation group get together
8. Associate individual projects with task groups
9. Launch a core effort to construct a 1 km time series product (from AVHRR, SeaWiFS, MODIS).

<u>Modeling Approaches and Current Shortfalls</u>

The application of biogeochemical and hydrological models is clearly a central element of any regionalization strategy. The key question here is to identify which models are suitable for which class of questions at a regional scale.

The Candidates. Within LBA-Ecology several complementary modeling strategies are in place. The class of land-surface focused biogeochemical and hydrological models is represented by the groups working with the CASA, TEM, IBIS, SiB, CENTURY and similar environments (see the Modeling Workshop report by Potter et al for in-depth summaries WEB ADDRESS). While similar in principle, these models differ as to physiological and biogeochemical detail and time and space scales of interest. A significant difference between the models is how soil moisture is treated, and by extension hydrology. This point is important, as river discharge is one of the few directly-measurable parameters available at a regional scale.

The next class of models seen to be critical is the coupling of the mesoscale atmosphere to the land surface, in which scaling up from the plot to the boundary layer and then to the region is feasible. Within LBA, such an effort is being conducted (by Dias, Denning, Bakwin et al.), coupling the Regional Atmospheric Modeling System (RAMS)to SiB (though other SVAT models could be used). Nested grids with progressively higher resolution are used to cover the scales down to close to the plot. A product of this effort could be the daily meteorological model derived data close to the surface, including model-derived rainfall, for input to the CASA model or even to hydrological models. Integrating parameters such as the height of the atmospheric mixed layer may be the focus of not only the numerical modeling effort but also, and perhaps more importantly, as a requirement for extra effort from the observational point of view.

Model Suitability. Application of these models to the regionalization problem raises two classes of issues. The first and most obvious is data requirements. Significant effort is required to provide remote sensing data on vegetation classification and soil type for the several scales. These issues will be discussed further below. Care needs to be taken in not having crossovers between validation and calibration. Data realities and model construct leads to the second issue, the suitability of a particular model to address a regional scale question. Does averaging used to cover large areas result in a loss of critical effects.

Especially Difficult Parameters. Within the overall models, several common parameters were considered to be the most problematic in being represented regionally. That property represented in all models called "soil moisture" is important to hydrology, NPP, mineralization, trace gases, etc. Yet its treatment is highly subjective. Regional interpretation of this variable is difficult because of its interaction with rooting depth which may be spatially highly variable. The group concluded that at a minimum the models for soil moisture should be described explicity. The group promotes an inter-comparison of methodologies (see below for further discussion).

<u>Regionalization of High-Resolution "Structural" Data</u>

Soil Texture and Chemistry and Rooting Depth. Models will be no better at a regional representation than the underlying data. Soil texture and chemistry and the interplay with rooting depth present critical issues at regional scale. For example rooting depth is positively correlated with Ca and negatively with Al. If soils become more depleted in Ca and enriched in Al going westward, rooting depth will be reduced. But how much where? Soil texture to depth is a key parameter in all models. In addition to soil texture, Fe and Al oxides can dramatically alter soil physical properties. For example, plateau soils in the Manaus region have 60-85 percent clay but due to their excellent aggregation, they drain like sands. Many, if not all, regional descriptions of soils in the Amazon have a common heritage in the original RADAM work of 1000+ soil pits. This resolution is not sufficient to the goal of a 1-km regional effort. Cross-comparisons of the several more detailed local surveys (e.g., Manaus , Santarem) is improving the nomenclature association with physical and chemical properties. While not in the target areas of most LBA-Ecology projects, the description of soils in the Andean region of the basin is very sparse. It will require an explicit and non-trivial effort on the part of LBA to establish a suitable data base.

Vegetation Properties. Differences in basic vegetation attributes relative to biogeochemistry, ecosystem structure, and ecosystem physiology between regions may be considerable, but are not clear. Resolving above and below ground biomass between regions is important. But what are the best ways to come up with consistent estimates?

Topography, DEMs and Drainage Networks. Current topography and constructions of the DEMs necessary to characterize sites and derive river networks are constrained by the resolution of the GTOPO30 data, especially in the regions with very low gradients. This problem must be resolved. This issue was a major concern raised in the remote sensing workshop.

Direct Assessment of Land Surface Change and Biophysical Properties

The issue of direct assessment of surface properties is very much an issue of time and space scale. How does an individual tree canopy respond to moisture stress, versus a kilometers square patch? Can phenological changes be confused with land use change? How does land use change over time?

Land Use and Land Cover Change. Of central importance is a consistent detection of land use cover and land use change across regions. There are a number of groups working on this problem at the different sites, but it is not obvious that there are consistent standards across this work; different classes are not infrequently assigned to the same features. The Remote Sensing Workshop report outlines the status of these efforts.

Direct Detection of Surface "Biophysics". The aggregate of surface response to events ranging from episodic to seasonal to interannual is summarized in the net spectral signal seen by remote sensing. This is the underlying premise behind using NDVI as a proxy driver for modeling NPP. By extension time series of regional-scale land surface responses to changes in moisture and land use change regimes is central. But spectral measurements do not scale up from the local to the regional scale in a simple linear way. What is seen at the local (meters) scale where tower work is done is different from what is seen at the regional (kilometer) scale. In order to relate the regional measurements to the point measurements of parameters of interest we need to know what exactly the regional spectral signature is responding to on a time series basis. Such time series are feasible at the 1-kilometer scale of AVHRR, SeaWiFS and MODIS.

The Human Dimension. While most of the discussion has focused on the more physical aspects, incorporating the human dimensions of land cover into regional models of carbon flux is a challenge. Some of the issues include:

1. Scaling from property level behavior and land cover change to regional scale atmospheric models
2. Adaptations of farming to global warming and fire risk
3. Temporal and spatial variation in CO_2 release and its importance on regional gaseous transfer flux.

The actions that need to be taken include:

1. Integrate modeling efforts across scales
2. Introduce human behavior into land cover change mechanism
3. Consider feedbacks of climate change on farming behavior, mainly through fire hazard and risk.

Direct measurement of regional-scale fluxes – what would it take?

All the work described so far is related to indirect measurements and assessment of fluxes. What is crucial is to have the capability to make regional validation measurements of those properties accessible to such measurements. These fall into (at least) 2 classes those related to gas concentration and flux and those related to water.

Atmospheric Fluxes Concerns: Understanding the Meteorology of Gas Emission and Concentration Closure. There are limited resources in LBA-Ecology dedicated to this task so we need to be very efficient. We have 2 different approaches which address different spatial and temporal scales.

1. Regular (i.e. weekly) aircraft vertical profiles over a coastal site and an interior site, with interpretation of data within a large-scale (regional/global) model.
2. Intensive aircraft tower campaigns where many vertical soundings are obtained over many days and can get boundary layer budget for CO2 (description of Wendy Chou and Steve Wofsy's work, calculating column integrals (equation given).

Questions: How much effort will we put into these two approaches? Who will be involved and which aircraft (rentals, INPE Bandeirante) will be used. Where will we do the sampling? Should we develop a coordinated proposal for additional aircraft work along these lines?

Estimates of CO_2, CO, and CH_4 emissions have rarely been compared to changes in the regional atmosphere. Where tower flux measurements have been made, there are questions of representativeness. Models have always been called in to generalize the local emissions estimates. The NOAA sampling effort looks to use concentration changes observed in the atmosphere to effect closure (i.e., to compare regional emissions estimates to gas concentration data collected during aircraft sampling). The potential that we are missing large surges of, e.g., methane emission during river-fall periods, emphasized that our regional budgets summaries are neither tested nor certain.

Discussion indicated some regions and types of sampling that are useful to make this aircraft closure technique work. Regions for good sampling were identified. Santarem and the region downwind were a favorite site, since emission estimates should be better constrained there. However, there was grave concern that the larger-scale flows affecting concentrations were not well understood. Meteorological modeling can help, either qualitatively ("this flow regime is too complex") or quantitatively ("our 3-d flux and concentration estimates work very well with your airplane-derived concentrations"). Radiosonde launches describing the sampling situation were very highly stressed by all scientists. The number of sondes and launches need not be extravagant. Weekly, afternoon radiosonde launches near the aircraft profiles (e.g., at Santarem) would tell us where our models, simple or sophisticated, were working. In addition, there should be perhaps 4 or 5 studies with 4 sondes per day, so as to check wind shifts and local circulations generated by river systems, topography, and mesoscale "chaotic" processes.

Soil Moisture, Related Fields. As noted above, "Soil Moisture" is the general name for a variety of variables which are used in a broad range of models used in LBA, e.g., those defining vegetation coverage, soil and vegetative emissions, large local-area surface flux estimates, and regional meteorological simulations. Meteorological simulations of Amazon winds and rain depend strongly on moisture estimates for large surrounding land areas, e.g., the Cerrado. It was emphasized that "soil moisture" variables cannot be blithely transferred from one model to the other. However, it was also clear that very broad features of soil moisture are often guessed rather qualitatively. Climatic averages for a month may be used even when interannual variability is clear.

We proposed that each group using such moisture variables over large regions simply make public their analyzed or modeled soil moisture variable on the web. These public estimates are not considered to be normative or final. Various scientists indicated the amount of guesswork or ignorance inherent in what they used. The use of the published fields would be for mutual aid and encouragement. The most important fields would describe the dry-down process, i.e., very large swings in the variables. Wet-up, especially the spottiness of wet-up by stochastic rain events, is important but more complex.

Moisture fields described at the large scale should be shared; approximately ten-day time increments appear appropriate. It is assumed that investigators will check out others' fields and make incremental improvements as they discover important features.

Statistical Properties of Rainfall. Rainfall is not perfectly predicted in Amazonia, or anywhere. Nevertheless meteorological models tend to capture the intermittence of rainfall in time somewhat better: the storm is simply mislocated, but averaging improves certain estimates. Ecological models generally have used monthly averaged rainfall, and thus tended to miss details of major rainfall-driven events. We encourage meteorological modelers and analysts to make public the number of rainfall days per month on their existing grid. We hope that this reporting can be integrated in simulation activity proceeding after this point.

River Discharge Measurements. River discharge is a direct unambiguous measurement at a regional scale. Hence, used as a validation measurement, discharge can contribute significantly to constraining regional budgets.

3.0 Site-Based Organization

The science team concluded that it is important to have site-based coordination of the science activities. Each site group selected representatives to coordinate their local activities and serve as contact points. Coordinators will help to maintain site maps, coordinate schedules of visits and manage the allocation of vehicles and other equipment and facilities.

Proposed Organization for Site Coordinators

Coordinator	Email	Role
Acre		
Elsa Medoza	seletro@mdnet.com.br	co-coordinator
Antonio Willian de Mello	willian@cpafac.embrapa.br	co-coordinator
Foster Brown	fbrown@mdnet.com.br	co-coordinator
Amazon Region		
Brasilia		
Heloisa Miranda	hmiranda@guarany.cpd.unb.br	site coordinator
Mercedes Bustamante	mercedes@guarany.cpd.unb.br	assistant coordinator
Jair Maia		site assistant
Heloisa Miranda	hmiranda@guarany.cpd.unb.br	advisory panel member
Richard Zepp	zepp.richard@epamail.epa.gov	advisory panel member
Daniel Nepstad	dnepstad@whrc.org	advisory panel member
John Grace	jgrace@ed.ac.uk	advisory panel member
Manaus		
Elisa Wandeli	elisa@cpaa.embrapa.br fbraga@internext.com.br	site coordinator
Rita Mesquita	rita@buriti.com.br	site coordinator
Luis Martinelli	zebu@cena.usp.br	advisory panel member
Erick Fernandez	ecf3@cornell.edu	advisory panel member
Niro Higuchi	niro@internext.com.br	head site coordinator
Santarem		
Bill Munger	jwm@io.harvard.edu	site usage coordinator
Lisa Zweede	zweede@pop900.gsfc.nasa.gov	vehicle maintenance, local logistics
Gladys Martinez	embrapa@tap.com.br	EMBRAPA Liason
Rondonia		
Alex Krusche	alex@mail.cena.usp.br	Operations Co-coordinator
Marcos Pedloski	pedlowma@rol.com.br	Operations Co-coordinator
Oliver Chadwick	oac@geog.ucsb.edu	Operations Co-coordinator
local (NASA hire)		local logistics assistant

4.0 Data Policy - (Leaders: Jose Marengo and John Melack)

The group reviewed the SSC data policy in detail (Appendix 4). Overall agreement and endorsement was obtained. However, the discussion group was small. The group urges the distribution of the policy again to the whole team and the encouragement of response.

Several questions and comments raised in the discussions are highlighted here.

1. What is LBA generated data? Would long-term data collected prior to LBA, but incorporated into analysis done during LBA be considered LBA data? We assumed that such data would not be LBA data.

2. What are data? Would all model outputs need to be archived? Would all very high frequency data, such as those collected during eddy correlation studies, need to be archived?

3. What is a module? If conflicts and initial data exchange are handled by modules, the policy needs clarification of what constitutes a module. We assumed that modules are funded units, e.g. LBA-Ecology, Brazil or EUSTACH. The coordination of the scientific activities of these modules is the responsibility of the SSC.

4. It is important to identify data that are associated with theses. For example, generic data or meteorological data may be used in support of the student's research. Exceptions may be required where unique data related to a thesis may be protected from prior publication. Protection from publication does not imply protection from all other legitimate uses such as unpublished data comparisons, inter-calibrations, etc.

5. The need to establish and LBA-wide DIS with funding coordinated by the OIC should be addressed. NASA Program Management has established this as a priority.

6. The source of all data within the DIS, should be clearly identified with specific investigators.

7. A copy of all data (once defined) must be deposited with the Co-I and with the central DIS at CPTEC.

5.0 Publications - (Leaders: Paulo Artaxo and Sue Trumbore)

The publication policies established by the SSC were reviewed and endorsed (Appendix 4). Special attention was directed toward authorship. Because LBA-Ecology scientists work in groups, papers should be authored by groups. There should be few, if any, single authored papers. The publication policy states that "publications resulting from work under LBA should be co-authored by all scientists who have participated *substantially* in the work, unless some participant chooses not to be an the author's list." The definition of *substantially* needs to be clarified among the members of each research group. Also "special effort by each non-South American researcher should be put into integration of South American researchers in their work and in the publication of the results." Because international interactions may be slow, researchers must make a special effort to leave adequate time for review by co-investigators.

Whenever data is shared among groups, the researcher originating the data should be cited if not included as a co-author. It is best to talk *directly* with the researcher about the use of their data. Conflicts may occur. The Project Scientist should be consulted to help resolve conflicts. In difficult cases or in cases where the Project Scientist has a conflict of interest, the Project Scientist has the option of appointing a committee to resolve questions that may arise.

A few new points were raised. The different cultures of publications in various disciplines and countries should be respected. Some Brazilian institutions require that the Ph.D. thesis include exclusively research material that has never been published. Some Ph.D. theses could require several years to develop and be defended.

The group recommended that one major LBA overview paper be written and submitted to *Nature* or *Science* so people can reference it for experimental design and planning. It was suggested the SSC determine who will write this paper. Special issue or specific topic publications were discussed. The group recommends publication mainly in disciplinary areas (e.g. plant physiology, or atmospheric chemistry, or social sciences) in smaller groups rather than in only one place. LBA investigators should encourage publications that integrate across disciplines and LBA components and avoid "molecular papers" that split work into very narrow areas.

During the discussion session, Adilson Serrao raised a concern that there is no policy concerning the language in which these papers should be published. Sue Trumbore stated that this is up to the individual groups and the data should be published where it is best exposed. Michael Keller agreed that a researcher should consider the intended audience to help answer questions of language and where to publish the data.

6.0 Laboratory Policy - (Leaders: Plinio Camargo and Eric Davidson)

Organization of comparison of standards among analytical laboratories

The need for laboratory intercomparisons for the sake of quality control of chemical analyses was discussed at the first science team meeting, and it continues to be a concern expressed by the scientists present at this meeting. After discussing various options for organizing this comparison, it was tentatively agreed that the CENA/MBL groups would investigate the possibility that they might coordinate the preparation and distribution of the following standards:

Soils: Chris Neill and Carlos Cerri – stored samples from Rondonia
Plant tissues: Plinio de Camargo
Water samples: Alex Krusche and Linda Deegan

For the stable gases, N2O, CH4, CO2, we suggest that the LBA-Ecology office purchase suitable standards of these three gases in air (a "God Gas") and that they circulate cylinders of gas among LBA research sites so that individual investigators can compare their working standards to these common standards. Many groups studying soil respiration and leaf processes will have their own working CO2 standards that should be cross-checked. Fewer groups will be using N2O and CH4 standards, but these gases might as well be included in the same cylinder of standard gas so investigators' working standards of N2O and CH4 can also be compared. It was suggested that Patrick Crill might be able to provide the LBA-Ecology office with advice about how to obtain these standards, the appropriate size cylinder, etc. Circulation of the God Gas cylinder seems to be an appropriate activity that should be requested of the LBA-Ecology office. Other components of the wider LBA project may also benefit from the circulation of the God Gas, and they should be included.

For more reactive gases, such as NO, CO, O3, and NMHC, we felt that more research is needed into the feasibility of circulating standards of these gases. It was suggested that Peter Bakwin from NOAA be contacted, as well as the three tower groups, Patrick Crill, Paulo Artaxo, and Alex Guenther who are the likely users of these gases. Perhaps a small group needs to meet together to work out their own arrangement.

Capacity Building of Analytical Laboratories

There are some centralized LBA activities in this regard, such as the efforts of the LBA offices in building a small field laboratory near Santarem and working to improve laboratory conditions at research and teaching institutions in locations such as Rio Branco and Santarem. However, the LBA-Ecology program is mostly decentralized; each PI and his/her co-PI partners are expected to resolve their own needs for analysis of samples. In the event that an investigator cannot find a Brazilian laboratory for analysis of specific samples, it is recommended that the investigator ask for advice from other investigators who have such connections or ask for help from the central LBA office. The group does not recommend the formation of a special committee for this purpose.

We expect that significant improvements of capacities of Brazilian, especially Amazonian, analytical laboratories will result from case-by-case collaborations among PI's and their Brazilian partner co-PIs. This goal has been clearly stated numerous times, and it is now up to the individual investigators to see that it happens. There were already signs at this meeting that this process is occurring, as several options of renovating equipment and donating equipment were discussed in various informal small groups at coffee breaks.

Exporting of samples for analysis outside of Brazil

The goal of maximizing sample analysis within Brazil and minimizing the need to export samples was stated clearly at the first and second science team meetings and was re-emphasized at this meeting. It was also recognized that there will be some instances where analysis within Brazil will not be possible, either because the necessary instruments do not exist (such as an accelerator mass spectrometer) or because the capacity of collaborating Brazilian laboratories has been exceeded. Comparison of analyses done on sub-samples of the same samples at both Brazilian and North American laboratories would also be a valid scientific reason for exporting a sub-set of samples. The LBA central office has recently proposed a procedure for acquiring permission to export samples in these cases.

In some cases, where the capacity of the laboratories of Brazilian LBA partner institutions has been exceeded, it might be possible to find another Brazilian laboratory outside of LBA that would conduct the analyses for a fee. However, this arrangement may be unsatisfactory if the fee is high, the wait is long, and there is no meaningful scientific engagement of the laboratory beyond the fee-for-service arrangement. Because the goal of the LBA laboratory policy is to maximize meaningful participation in research among the scientific partners, a fee-for-service arrangement is to be avoided whenever possible. Either analysis at local collaborating laboratories or export of samples that are beyond local capacities would probably be preferable to sending samples to laboratories on a fee-for-service basis.

It is clear that there will be instances where samples will need to be exported to the USA or to Europe. In these cases, we must be careful to follow the Brazilian law very carefully and closely. The proposal made by the LBA central office does exactly this, while also providing the needed flexibility so that the research teams can get their analyses accomplished in an efficient manner.

The LBA central office has developed a form <http://lba-ecology.gsfc.nasa.gov/lbaeco/lab_sample_exportation.htm> to be filled out, with examples for soil, plant tissue, and water samples. The information needed for completing these forms is:

a. The number of samples
b. Type of analysis to be done
c. Deadline for sample analysis
d. The responsible researcher accompanying the analysis
e. The format for data from analysis that will be sent to INPE
f. The origin of the samples
g. The destination of the samples
h. Information on preservation/preparation techniques
i. Justification for the exportation

This form can be mailed or FAX'ed to the LBA central office. In effect, the LBA office at INPE/CPTEC has the authority to authorize the export, but it must inform the Ministry of Science and Technology that the request has been made and granted. It should require only a few days for the LBA central office staff to review the information on this form and to forward it to the Ministry. At the same time that the information is sent to the Ministry, a copy of the memo to the Ministry will also be FAX'ed to the investigator at his/her Brazilian host institution. This copy can then be used to accompany the samples as they are exported.

It was agreed by the participants that this process is sufficiently flexible to meet investigators' needs, while also following the letter of the Brazilian law. The LBA central office will be depending upon the trust and good will of investigators (American, Brazilian, and European) that they are requesting permission to export only those samples that cannot reasonably be analyzed in a timely manner by the Brazilian partner institutions within LBA, and after having also made considerable efforts to build the capacities of those laboratories.

7.0 Training and Education (leaders: Foster Brown, Jim Ehleringer, Christopher Martens, Luis Martinelli)

The training and education goal of LBA is to build the human resource capacity necessary to generate, apply, disseminate and amplify the scientific results of the Large-Scale Biosphere Atmosphere Experiment in Amazonia. (Tentative definition). Two breakout groups were formed to insure that representatives from all 40 projects attended a discussion. The coordinators of the training and education discussions passed out surveys to all participants. Surveys were completed by 24 out of the 40 projects. Currently, there are 21 post-docs involved in LBA, only 30% are resident at Brazilian institutions while 70% are resident at non-Brazilian. Of these positions, 67% are funded by the US (primarily NASA), while 19% are through FAPESP and the remaining 14% from other sources. There are 65 students of Master's and PhD level combined. Of the PhD, Master’s and undergraduate students 65% participating in LBA are Brazilian. For students, 47% of the funds derive from NASA LBA-Ecology while 20% are funded through FAPESP, scholarships for students from the State of Sao Paulo, Brazil.

There still exists a need to make links, formal and informal, with Amazon institutions, particularly universities. The objective of establishing institutional relationships, is to extend their utility beyond the personal scope of the LBA participants. In this way, the relationships may last beyond the duration of the LBA project itself. For example investigators can use LBA to help link their institutions with graduate programs in relevant areas (E.g. NAEA, UFPa, INPA, and UFAC). Funding within Brazil exists for students at the undergraduate and graduate levels. CAPES, CNPq (PIBIC scholarships). Other sources include LASPAU, Fulbright, and private foundations.

The group suspected that there are difficulties recruiting qualified Amazonian graduate and undergraduate students. The group suggested that it is important to invest in undergraduate students during these coming 2 years. The undergraduate student of today is the graduate student of tomorrow. In Santarem for example there are 40 senior students needing to prepare research monographs as part of their biology degree. Investigators from 10 LBA projects surveyed indicated a need for 3 students (on average) available on a part-time basis. These students have a variety of needs: funding for expenses to complete their monographs while working in LBA projects, modest scholarship support, connections with local advisors, or just direct involvement with local project research groups. One pathway for acquiring new students is first to find local contacts, then to present seminars and/or short courses and then finally to identify and select students from those courses for participation in research projects. Amazonia is not only in Brazil, but includes other countries that need to be considered in training programs.

A variety of seminars and a few short courses have already been given. Course topics have ranged from carbon cycling to meteorology to the use of towers in ecosystem studies.

Topics suggested for other 2 week-long short courses are: atmospheric chemistry, stable isotopes, data analysis and biostatistics, field techniques in ecosystem ecology, remote sensing, forest hydrology, an introduction to modeling, soils and geomorphology, limnology, socio-economic analysis, biogeochemical cycling. There are many logistical issues involved in arranging these courses that would need to be considered. Documentation of all courses including the syllabi, notes, handouts and reference lists is very useful and should be made available as soon as possible. The teaching material (e.g. key scientific articles) should be produced in Portuguese so they can be easily used by the teachers and students of the Amazon region. Non-Portuguese speaker should seek help from their counter parts in developing and translating these documents.

The group identified a number of contacts to help find students and local professors:

Belem**:** Prof. Jose Carvalho de Moraes, Depto. de Meteorlogia, UFPa, Carvalho@ufpa.br

Prof. Francisco de Assis Oliveira, Depto de Ciências Florestais FCAP, Caixa Postal 917, Belem, PA 66.077-530. Tele: 091-274-2233. fassis.bel@zaz.com.br

Santarem: Prof. Aldo Gomes Queroz, Coordenador Geral do Campos da UFPa , Queroz@tap.com.br Tele: 091-523-1087, Fax: 091-523-2258
Prof. Graça Pires, botanica, Prof. Recardo Bezerra, neurociência

Rondonia: Dr. Alex Krusche/ Dr. Marcos Pedlowski, a lex@cena.usp.br 019-429-4610/ pedlowma@uenf.br –024-726-3783

Manaus: Dr. Rita Mesquita, rita@buriti.com.br, Tele: 092-642-1148, Fax: 092-642- 2050

Brasilia: Dr. Heloisa Miranda, hmiranda@guarany.cpd.unb.br

Acre: Eufran Ferreira do Amaral, Embrapa, Eufran@mdnet.com.br Tele: 068-224-3931. Cel: 068-985-4536

General Communication: Dr. Jimena Felipe Beltrão, jimena@ufpa.br

Appendix 1. LBA-Ecology Third Science Team Meeting Agenda, April 19-21, 1999

Sunday, April 18

6:00 PM - 8:00 PM	Early Registration

Monday, April 19

7:30 AM	Registration
8:00 AM	Welcome - M. Keller LBA-Ecology Program - D. Wickland The State of LBA - C. Nobre The LBA Central Office - I. Weissberg The LBA-Ecology Implementing Arrangement - D. Hodge/I. Weissberg LBA-Atmospheric Chemistry - P. Artaxo LBA-Atmospheric Mesoscale Campaign - M.A. Silva Dias
10:00 AM	Coffee Break
10:30 AM	LBA-EUSTACH - P. Kabat LBA-Hydrometeorology, an Introduction - R. Avissar LBA-Ecology Project Office - D. Deering Science Support - S. Sandmeier Infrastructure Update, Schedule - D. Hodkinson DIS Update - M. Gentry Outreach/Training & Education - J. Wiles Schedule and Introduction to Site Breakouts - M. Keller
12:30 PM	Lunch
2:00 PM	Site Breakout Discussions (1) Acre - F. Brown/E.F. do Amaral Amazon Region - J. Richey/M.A. Silva Dias Brasília - R. Zepp/A. Moreira Manaus - E. Fernandes/R. Mesquita Santarém - D. Nepstad/O. de Moraes Rondônia - L. Deegan/M. Pedlowski
3:30 PM	Coffee Break
4:00 PM	Site Breakout Discussions (2)

Monday, April 19 - Continued

6:00 PM Adjournment

6:30 PM Reception

Tuesday, April 20

8:00 AM	Reports of Workshops and Other Science Team Activities Regional Modeling Workshop Report - C. Potter Santarém Site Selection Report - P. Crill Secondary Forest Workshop Report - R. Walker Remote Sensing Workshop Report - J. Melack
9:00 AM	Charge to Special Topics Groups - M. Keller
9:15 AM	Long Topics Groups(1) Data Policy - J. Melack/J. Marengo Publication Policy - S. Trumbore/P. Artaxo Labs/Chemical Analysis/Standards - E. Davidson/P. Camargo Training & Education (1) - J. Ehleringer/F. Brown Training & Education (2) - C. Martens/L. Martinelli Regional Geographic Data Room
10:15 AM	Coffee Break
10:45 AM	Long Topics Groups (2)
12:15 PM	Lunch
2:00 PM	Science Talks - Featuring Work in Belém EMBRAPA and LBA - A. Serrão Fallow Vegetation Associated with Slash-and-Burn Agriculture - T. Sá Nutrient Cycling in Amazonia - A Review of the Literature - F.A. Oliveira Fauna and Secondary Vegetation - P. Moutinho Plant Species in Secondary Vegetation - I. Vieira Research on Silviculture in Eastern Amazonia - N. Silva
3:30 PM	Coffee Break

Tuesday, April 20 - Continued

4:00 PM Short Topics Group Discussions
Primary Forest Productivity -
Data/Model Comparison - M. Williams/Y. Malhi
Secondary Forest - Social/Biophysical
Linkages - R. Walker/M. Caldas
Remote Sensing Follow-on - J. Melack/E. Novo
Canopy Studies - M. Goulden/C. De Carvalho

6:30 PM Adjournment

Wednesday, April 21

8:00 AM Reports from Group Discussions
Report - Acre
Report - Amazon Region
Report - Brasília
Report - Manaus
Report - Santarém
Report - Rondônia
Report - Data Policy
Report - Publication Policy

10:00 AM Coffee Break

10:30 AM Reports (continued) and Discussion
Report - Labs/Chemical Analysis/Standards
Report - Training & Education (1)
Report - Training & Education (2)
Discussion

12:00 Noon Lunch

Adjournment

Appendix 2. LBA- Ecology Science Team Members and Investigation Titles

Code #	US Investigators and Others	South American Investigators	Investigation Title
LC-01	**Billsborrow, Richard** **Walsh, Stephen** Band, Lawrence Moody, Aaron Murphy, Laura	Garcia, Mario	Agricultural colonization on the Ecuadorian Amazon: Population, biophysical, and geographical factors affecting LUCC and landscape structure
LC-02	**Brown, Foster** Stone, Thomas	Setzer, Alberto	Land-cover/land use change and carbon dynamics in an expanding frontier in western Amazonia: Acre Brazil
ND-01	**Chadwick, Oliver** Roberts, Dar Gessler, Paul	Tomasella, Javier Batista, Gertulio + Others from INPE	Land cover conversion in Amazonia, the role of environment and substrate composition in modifying soil nutrient cycling and forest regeneration
TG-01	**Chatfield, Robert** Thompson, Anne	Silva Dias, Maria Assunsao Artaxo, Paulo Freitas, Saulo Longo, Karla	Cooperative regional transport modeling of C and N for Amazonia
ND-02	**Davidson, Eric** Stone, Thomas Belk, Elizabeth Klingerlee, Wendy	Sa, Tatiana Carvalho, Claudio Moutinho, Paulo Dias-Filho, Moacyr Moller, Regina Vieira, Ima Guimaraes	Biogeochemical cycles in degraded lands
ND-03	**Deegan, Linda** Neill, Christopher Peterson, Bruce Thomas, Susan	Victoria, Reynaldo Krusche, Alex	Linking soil biogeochemistry to surface water chemistry in small drainage basins of the Amazon
CD-01	**Denning, Scott** Desjardins, Raymond	Silva Dias, Pedro Silva Dias, Maria Assunsao Rocha, Humberto	Spatial integration of regional carbon balance in Amazonia
LC-03	**Dobson, Craig** Pierce, Leland Burnham, Robyn	DiGrandi, Gianfranco Soares, Joao Valeriano, Dalton	Radar remote sensing of landcover and biomass in the Amazon
CD-02	**Ehleringer, James** Flanagan, Lawrence	Martinelli, Luiz	Carbon and oxygen isotope ratio CO_2 flux analyses at the soil, canopy and landscape scales
ND-04	**Fernandes, Erick** Duxbury, John Riha, Susan	Silva, Neliton Perin, Rogerio Garcia, Silas Wandelli, Elisa	Carbon and nutrient stocks, soil water dynamics, and trace gas fluxes in abandon pastures and agroforestry systems in the Central Amazon
CD-03	**Fitzjarrald, David** Moore, Kathleen	Moraes, Osvaldo Acevedo, Otavio Sakai, Ricardo	Periodic, transient, and spatially inhomogeneous influences on C exchange in Amazonia
LC-04	**Foley, Jonathan** Norman, John Prentice, Colin	Costa, Marcos	The effects of tropical forest conversion: Ecological research in LBA
LC-11	**Freeman, Tony**	Dutra or Nelson?	JERS-1 Amazon multi-season mapping study (JAMMS)
LC-12	**Frohn, Robert**	Pedlowski, Marcos	Using Landsat data to develop an image-based logistic regression model for predicting deforestation in the Amazon

Code #	US Investigators and Others	South American Investigators	Investigation Title
LC-05	**Laurance, William** Bergen, Scott Bradshaw, Gay Steininger, Marc Tucker, Compton	Mesquita, Rita Pacheco, M. Venticinque, Eduardo Williamson, G.	Anthropogenic landscape changes and the dynamics of Amazonian forest biomass
ND-06	**Gholz, Henry** Smith, Kenneth	Oliveira, F. Assis	Nitrogen and phosphorous dynamics in forests and converted forest sites in the Amazon Basin: A review and synthesis of previous research
CD-04	**Goulden, Michael** Miller, Scott Litvak, Marcy	Rocha, Humberto	Measuring the effects of logging on the CO_2 and energy exchange of a primary forest in Tapajos National Forest
TG-02	**Guenther, Alex** Brasseur, Guy Harley, Peter Greenberg, Jim Klinger, Lee	Artaxo, Paulo Vega, Oscar Tavares, Tania Gatti, Luciana Vanni Vasconcellos, Perola	Influence of Amazonian land-use change on chemical constituents in the atmosphere
TG-03	**Holben , Brent** Eck, Thomas Markham, Brian	Artaxo, Paulo Setzer, Alberto	Characterization of aerosal optical properties and column water vapor for LBA-Ecology
CD-11	**Houghton, Skee** Stone, Thomas Lawrence, Kira	Souza, Carlos	Selective logging, fire, and biomass in Amazonia
LC-06	**Huete, Alfredo** Justice, Christopher Myneni, Ranga Running, Steve Townsend, John Muller, Jan-Peter	Shimbokuro, Yosio Epiphanio, Jose Sano, Edson Batista, Getulio Ferreira, Laerte Guimaraes	Validation and evaluation of MODIS data products in LBA
TG-07	**Keller, Michael** Crill, Patrick Li, Changsheng Silver, Wendee	de Mello, William Cosme, Raimundo Lopez, Evilene	Soil biogeochemistry of carbon, nutrients, and trace gases in the Amazon region of Brazil: Field and model studies of natural and managed conditions
TG-04	**Martens, Christopher** Crill, Patrick Albert, Daniel Mendlovitz, Howard	Moraes, Osvaldo Angela de Luca Rebello Wagener Kraemer, Maria	Radon-222 and stable carbon isotope tracing of carbon exchange and trace gas fluxes in old growth and selectively logged Amazonian forests
ND-08	**McNabb, Ken** Lockaby, Graeme	Luiz Gonzaga da Silva Costa	Soil organic matter fluxes in Amazonian forests: Natural vs intensively managed systems
LC-07	**Melack, John** Mertes, Leal	Novo, Evlyn Costa, Maycira	Multi-scale analysis of inundation with microwave and optical remote sensing in the Amazon Basin: Applications to biogeochemical measurements and modeling

Code #	US Investigators and Others	South American Investigators	Investigation Title
LC-08	**Moore, Berrien** Braswell, Rob Frolking, Steve Hurtt, George Mourcroft, Paul Pacala, Steve Peterson, Bruce Vorosmarty, Charles Xiao, Xiangming	Nobre, Carlos	Modeling the biogeochemical system of the terrestrial Amazon: Issues for sustainability
LC-09	**Moran, Emilio** Randolph, J.C. Mausel, Paul	Valeriano, Dalton Brondizio, Eduardo Ponzoni, Flavio	Human and physical dimensions of LUCC in Amazonia: Forest regeneration and landscape structure
CD-05	**Nepstad, Daniel** Cochrane, Mark Kingerlee, Wendy Bishop, Josh	Miranda, Antonio Moutinho, Paulo Miranda, Heloisa Moreira, Adriana	The present and future effects of ground fires on forest carbon stocks, metabolism, hydrology and economic value in Amazonia and Cerrado
TG-05	**Potter, Christopher** Coughlan, Joseph Alexander, Susan Klooster, Steve	Carvalho, Claudio	Modeling terrestrial ecosystem processes, carbon fluxes, and trace gas emissions for land cover/use type of the Amazon Basin
ND-09	**Richey, Jeffrey** Devol, Allan Hedges, John	Victoria, Reynaldo	Biogeochemical dynamics in river corridors of the Amazon Basin and their response to anthropogenic change
CD-06	**Richey, Jeffrey**	Ballester, Vicky Higuchi, Niro	Carbon and moisture fluxes along the LBA transects: Data assimilation and modeling
LC-10	**Skole, David** Walker, Robert Salas, William Wood, Charles	Homma, Alfredo Mourao, Pedro Caldus, Marcellus Pedlowski, Marcos	Measurement and modeling of the inter-annual dynamics of deforestation and regrowth in the Brazilian Amazon: Land use control on the annual net flux of carbon
CD-07	**Smith, Eric** Norman, John Gu, Jiujing Cooper, Harry	Silva Dias, Pedro	High resolution C exchange over large-scale Amazonia based on modeling and GOES satellite derived radiation inputs
TG-08	**Steudler, Paul** Neill, Christopher Mellilo, Jerry	Cerri, Carlos	Trace gas fluxes associated with land-cover and land-use changes in the Brazilian Amazon Basin
TG-06	**Tans, Pieter** Bakwin, Peter	Artaxo, Paulo	Vertical profiles of CO_2 and other trace gas species over the Amazon Basin using small aircraft
ND-10	**Townsend, Alan** Asner, Gregory Clevland, Cory Neff, Jason	Bustamante, Mercedes Cardinot, Gina Nardoto, Gabriela	An integrated use of experimental, modeling and remote sensing techniques to investigate carbon isotope and phosphorous dynamics in the humid tropics
CD-08	**Trumbore, Susan** Southon, John Chambers, Jeff Perez, Tibisay	Martinelli, Luiz Camargo, Plinio Costa, Enir	Carbon dynamics of re-growth forests in the eastern Amazon
CD-09	**Williams, Mathew** Rastetter, Edward	Shimbokuro, Yosio Joao Soares	A modeling synthesis of the impacts of tropical forest conversion on carbon fluxes and storage, and on nutrient dynamics in Amazonia

Code #	US Investigators and Others	South American Investigators	Investigation Title
CD-10	**Wofsy , Steven** Munger, William Daube, Bruce Barford, Carol	Kirchhoff, Volker Artaxo, Paulo	Net ecosystem exchange of CO_2 and H_2O from primary tropical forest in central Amazonia
ND-07	**Zepp, Richard** Burke, Roger Molina, Mariosa	Bustamante, Mercedes	Impacts of deforestation on carbon and nutrient cycles and trace gas exchange in Amazonian soils

Appendix 3. Site Specific Measurements (This list includes those measurements submitted at the Third Science Team Meeting. It may not be fully inclusive.)

3.1 BRASILIA SITE

ND-02 Biogeochemical cycles in degraded lands

site	**ecosystem**
IBGE, Aguas Emendadas	cerrado stricto senso, campo sujo

treatments
recently burned, control, rainfall exclusion
measurements
CO_2 soil fluxes
chemistry of rainwater, throughfall, soil solution, stream water (NH_4, NO_3, TON, DOC, total P, Ca, Mg, K)
soil nutrient stocks and litter fall (total N, P, Ca, Mg, K, C, extractable P, Ca, Mg, K)
frequency
monthly or biweekly
Logistics Requirements
Vehicle for equipment transport, lab space for water, soil analyses, web access

LC-03 Radar remote sensing of landcover and biomass in the Amazon

site	**ecosystem**	**treatments**
IBGE		fire

measurements
Land cover class (using archival orbital imaging radar data)
Above-ground biomass (tree counts, diameter, height, biomass)
frequency
once annually for one or two weeks beginning in October 1999
Logistics Requirements
Transportation and lodging for 3 people, lab and office space, mobile and base station GPS

INCO-DC (SAVAFLUX)

site	**ecosystem**
IBGE, Aguas Emendadas	cerrado stricto senso, campo sujo and other nearby disturbed sites

treatments
recently burned, control, crops, pastures
measurements
at the permanent tower site (campo sujo):
wind speed (cups), wind direction and wind vane (3 m),
CO_2, H_2O, momentum (eddy flux), temperature (top only),
CO_2 profile and integrated column amount (0-3m),
long-wave and short-wave radiation, PAR (down)
rain guage
at the mobile towers:
CO_2 and H_2O (eddy flux)
at all locations:
Soil temperature, ambient pressure and PAR sensors (ground level)
Frequency
continuous
Logistics Requirements
Vehicle for equipment transport, lab space for equipment maintenance and repairs, web access

TG-02 Influence of Amazonian land-use change on chemical constituents in the atmosphere

site
IBGE, Aguas Emendadas
measurements
VOC (isoprene, monoterpenes), oxidation products (MeOH, acetone, etc.) using leaf/branch enclosures
mixed layer CO2, boundary layer height, temperature, RH profiles, O3? using balloon and tower
Fequency
once per year during the wet season
Logistics Requirements
Vehicle for equipment transport, 3 meters of lab banch space for gc analysis, etc

TG-03 Characterization of aerosal optical properties and column water vapor for LBA-Ecology

site	**ecosystem**
IBGE, Aguas Emendadas	cerrado stricto senso

Measurements
Rainwater sampling - nutrient fluxes -NH4, NO3, etc, IC, ICPMS
Aerosol composition - fine and course fractionation, trace elements, black C, ICPMS
Frequency
continuous beginning November 1999
Logistics Requirements

CD-05 The present and future effects of ground fires on forest carbon stocks, metabolism, hydrology and economic value in Amazonia and Cerrado

site	**ecosystem**
IBGE, Aguas Emendadas	cerrado stricto senso, campo sujo

treatments
recently burned, control, rainfall exclusion
Measurements
TDR, pits, every meter, soil water retention curves, texture, bulk density
fine root biomass to 8m, coarse root biomass to 10m
qual. phenology (only rain. excl.)
litter production (mass), fuel load (mass)
eddy correlation (H2O, CO2)
Frequency
monthly or biweekly
Logistics Requirements
Vehicle for equipment transport, lab space for vegetation, litter drying and weighing

ND-07 Impacts of deforestation on carbon and nutrient cycles and trace gas exchange in Amazonian soils

site	**ecosystem**
IBGE, Aguas Emendadas	cerrado stricto senso, campo sujo

treatments
biennel burned, control, UV/rainfall exclusion
Measurements
Soil microbial biomass (isotopic analyses of PLFA's -GC/IRMS)
Soil nutrient pools (total N, P, Ca, Mg, K, C, extractable P, Ca, Mg, K)
Soil N cycling dynamics, CO2, CO, N2O, NO fluxes (chambers/enclosures- GC)
Soil texture, bulk density, moiture (TDR), temperature profiles, organic carbon
Solar irradiance (total, UV-B, UV-A)

3.2 MANAUS SITE

LC-05 Anthropogenic landscape changes and the dynamics of Amazonian forest biomass

Site
PERMANENT PLOTS IN PRIMARY FOREST
Period
once
Measurements
growth (for $\geq$10 cm DBH trees) using standard DBH tapes
biomass estimates for small (<10 cm DBH) trees, lianas, vines, forbs, leaf litter, and coarse and fine woody debris
rates of tree mortality, damage, recruitment,
Site
STUDIES OF REGROWTH FOREST - Thirty 0.09 ha permanent plots in regrowth chronosequences
Period
once per year for 3 years
Measurements
sizes of all stems $\geq$1 cm DBH
Floristics data - all $\geq$1 cm stems
Destructive and non-destructive methods - estimate understory (forbs, vines, etc.) and tree biomass

ND-04 Carbon and nutrient stocks, soil water dynamics in abandoned pastures and agroforestry systems in the Central Amazon

Site	
Km 54 BR 174 (Manaus-Boa Vista) Abandoned pasture and 8-year old agroforestry systems	
Period	
July-99 to May-02	
Measurements	
Air temp – continuous	Rainfall – continuous
Irradiance (total and PAR) – cont.	Wind speed - cont.
Soil temperature (0,15 & 30 cm) – cont.	Wind direction – cont.
Relative humidity – cont.	
Physiology	
Species census of abandoned pasture chronosequence	Aboveground biomass (by species)
LAI	Litterfall biweekly or monthly
Litter-floor-root nutrient stocks	Litter decomposition - litter bags
Litter quality (polyphenol, tannin, lignin, C/N)	Rooting depth (fine and coarse roots)
Fine root turnover (continuous observation – minirhizotron)	Mycorrhizal fungi (species; percent root infection)
Soil Properties	
Soil moisture - biweekly (100 TDR inserts @ 2 m); monthly Neutron probe measures to 3 m)	bulk density - once (to 2 m), porosity, aggregate strength
Soil texture & structure - once (to 2 m)	C fractions (LUDOX)
Soil microbial biomass	P fractions (modified Heddley)
Soil nutrient pools (total N, P, Ca, Mg, K, C, extractable P, Ca, Mg, K)	
Soil macrofauna dynamics (once per season)	Termite and Ant mounds (No. per ha; total/avail nutrients; texture. BD)

CD-02 Carbon and oxygen isotope ratio CO2 flux analyses at the soil, canopy and landscape scales

Site
Forest - ZF2, Pasture ZF3
Period
Wet and dry seasons
Measurements
Carbon stocks related measurements
13-C and 18-O organic leaf tissues and tree rings
13-C organic soils (once only)
Carbon and water flux related measurements
18-O water source, soil water, leaf water
18-O H2O air vapor
13-C and 18-O CO2 air - profile and Keeling plot
13-C and 18-O CO2 soil efflux and soil profile
Leaf-level photosynthesis
leaf PS light response, A/ci response, humidity response
leaf N

CD-08 Carbon Dynamics of re-growth forests in the eastern Amazon

Site
Primary forest (ZF2) and pasture (ZF3)
Period
April 1999 - September 2002
Measurements
14-C CO2 soil efflux
14-C CO2 profiles - wet and dry season
14-C and 13-C soil organic matter, roots, leaves, detritus
C and N inventory, soil bulk density - soil transect of sand to clay
Tree diameter increments / wood production (400+ trees) - monthly dendrometer bands
Dead wood respiration (IRGA LICOR) - Dry season / wet season
Tree ages - radiocarbon samples of logged stumps and cores from standing trees
Radiocarbon in vegetation, detritus, soil organic matter
Precipitation - daily

TG-02 Influence of Amazonian land-use change on chemical constituents in the atmosphere

Site
ZF2
Period
wet season 2000 - 1-2 weeks
Measurements
using tower(s) -gradient and REA, leg/branch measurements, tethered balloon
VOC – isoprene, monoterpenes, oxidation products, hopefully oxygenated compounds such as MeOH, acetone, etc.
CO2 mixed layer averages
Characterization of boundary layer height, etc. Terp., RH profiles
Ozone (?, profiles, integrated column)

LC-03 Radar remote sensing of landcover and biomass in the Amazon

Site
The whole Manaus region
Period
Late August – 1st or 2nd week of September, 1999
Measurements
Land-cover, above-ground biomass/ SAR-derived estimates

3.3 SANTAREM SITE

ND-02 Biogeochemical cycles in degraded lands

Site
Primary Forest (km 67), Dry Down, & Secondary Forest Sites
Period
Oct-99 to Sep-02
Measurements
Trace Gas Fluxes
CO_2, CH_4, N_2O, NO - monthly
Soil Properties

N mineralization-net nitrification assays - 6 per year	soil-fauna activity - 6 per year
throughfall - weekly	soil C & nutrient stocks - once

LC-03 - Radar remote sensing of landcover and biomass in the Amazon

Site
Santarém Area
Period
Aug 1-15, 1999-2001
Measurements
Physiology
above ground biomass - once per year
LU/LC - once per year

CD-02 Carbon and oxygen isotope ratio CO2 flux analyses at the soil, canopy and landscape scales

Site
Primary Forest (km 67), Logged (km 83), & Pasture (km 67) Sites
Period
Oct-99 to Sep-02
Measurements
Physiology

photosynthesis	leaf N & P stocks
wet/dry seas (diurnal response/20 day)	wet/dry seas (N only/20 day)
wet/dry seas (light response/20 day)	
wet/dry seas (humidity response/20 day)	
13-C stocks	18-O stocks
wet/dry seas (organic/1-2 day)	wet/dry seas (organic/8-10 day)
wet/dry seas (organic by depth & size frac/1-2 day)	wet/dry seas (water source & leaf-soil water/8-10 day)
wet/dry seas (tree rings/1-2 day)	wet/dry seas (tree ring/1-2 day)
13-C/CO2 & 18-O/CO2 ratios	18-O/H2O ratio
4 per year (air prof & Keeling plot)	4 per year (air vapor prof)
wet/dry seas (soil efflux)	
wet/dry seas (soil prof)	

CD-03 Periodic, transient, and spatially inhomogeneous influences on C exchange in Amazonia

Site

Pasture Site (km 67)

Period

Oct-99 to Sep-02

Measurements

air temp - cont (prof @ 3 levs) with STDEV	rainfall - continuous
H2O mixing ratio - cont (prof @ 3 levs) with STDEV	wind speed - cont (prof @ 3 levs) with STDEV
pressure at the surface - continuous	wind dir - cont (prof @ 3 levs) with STDEV

Radiation

solar up and down - cont (20 m)	net (Q*) - cont (20 m)
infrared up and down - cont (20 m)	spectral shadowband - cont (dir & dif @ 5 VIS/NIR bands)
PAR up and down - cont (20 m)	skin temperature - cont (30 m) 2 sensors @ 0(?) and 45(?)

Trace Gas Contentrations

CO2 conc - cont (prof @ 3 levs)

Energy Flux

sensible heat (H) - cont (5 m)	momentum (3-axis Reynolds stresses) - cont (5 m)
latent heat (lE) - cont (5 m)	soil heat (G) - cont (2-5 cm)

Trace Gas Fluxes

CO2 flux - cont (5 m)

Soil Properties

soil temperature - cont (5 levs)	soil moisture - cont (2 levs)

CD-04 Measuring the effects of logging on the CO_2 and energy exchange of a primary forest in Tapajos National Forest

Site
Logged Site (km 83), Gap Site after Logging, & Intact Patch Site

Period
Oct-99 to Sep-02

Measurements

air temp with STDEV
- cont (main tower @ 65, 50, & 40 m)
- cont after cut (gap tower @ 65, 45, 15, & 2 m)
- cont (@ floor of intact patch site)

H2O mixing ratio with STDEV
- cont (main tower @ 65, 50, 40, 20, 10, 5, 2, 1, 0.5, 0.25, 0.1 m)
- cont after cut (gap tower @ 65, 45, 15, & 2 m)

pressure - cont (main tower @ 2 m) ?

wind speed with STDEV
- cont (main tower @ 65, 50, & 40 m)
- cont (gap tower @ 45, 15, & 2 m)

wind dir with STDEV
- cont (main tower @ 65, 50, & 40 m)
- cont (gap tower @ 45, 15, & 2 m)

rainfall
- cont after cut (gap site in clearing)
- cont after cut (gap site under foliage)
- cont after cut (intact patch site under foliage)

Radiation

solar up and down
- cont (main tower @ 65 m - 2 radiom)
- cont after cut (gap tower @ 65 m)

infrared up and down
- cont (main tower @ 65 m)
- cont after cut (gap tower @ 65 m)

PAR up and down
- cont (main tower @ 65 m)
- cont after cut (gap tower @ 65 m)

net (Q*)
- cont (main tower @ 65 m)
- cont after cut (gap tower @ 65 m)

Trace Gas Contentrations

CO2 conc
- cont (prof @ 65, 50, 40, 20, 10, 5, 2, 1, 0.5, 0.25, 0.1 m)

Energy Flux

sensible heat (H)
- cont (main tower @ 65 m)
- cont after cut (gap tower @ 65 m)

latent heat (lE)
- cont (main tower @ 65 m)
- discont after cut (gap tower @ 65 m)

soil heat (G)
- cont after cut (gap site @ 10 cm)
- cont after cut (intact patch site @ 10 cm)

momentum (3-axis Reynolds stresses)
- cont (main tower @ 65 m)
- cont after cut (gap tower @ 65 m)

Trace Gas Fluxes

CO2 flux
- cont (main tower @ 65 m)
- discont after cut (gap tower @ 65 m)

Soil Properties

soil temperature
- cont after cut (several depths @ gap site)
- cont (several depths @ intact patch site)

soil moisture
- cont after cut (several depths @ gap site)
- cont (several depths @ intact patch site)

Physiology

tree growth (dendrometers)
- cont (floors of gap and intact patch sites)

sapflow
- cont (floors of gap and intact patch sites)

respiration
- cont after cut (floors of gap and intact patch sites)

TG-02 Influence of Amazonian land-use change on chemical constituents in the atmosphere

Site
Primary Forest (km 67), Logged (83), & Pasture (67)
Sites
Period
3-4 weeks in 2001 wet season
Measurements
Trace Gas Contentrations
CO_2 conc - mixed layer ave (tentative)
Trace Gas Fluxes
VOC flux
    1-2 weeks (each tower)
    3-4 weeks (tethered balloon)
leaf/branch isoprene flux - 2-3 weeks

TG-03 - Characterization of aerosal optical properties and column water vapor for LBA-Ecology

Site
Santarem Area
Period
Oct-99 to Sep-02
Measurements
rain water comp - cont
Radiation
net (Q*) cont
sun photometer - cont
UV-A, UV-B - cont
aerosol conc & comp - cont
aerosol size dist & abs/sct optical properties - campaign basis
Trace Gas Contentrations on a campaign basis - VOC, O_3, NO, NO_2, CO

TG-07 - Soil biogeochemistry of carbon, nutrients, and trace gases in the Amazon region of Brazil: Field and model studies of natural and managed conditions

Site

Primary Forest (km 67), Logged (km 83), & Pasture (km 67) Sites

Period

Jan-99 to Sep-02

Measurements

rain water comp - 2 weeks (@ km 83)

Trace Gas Contentrations

CO_2, CH_4, N_2O, Radon - cont (prof @ 6 levs at km 67 & 83)

Trace Gas Fluxes

CO_2, CH_4, N_2O, NO - once per month (manual) and 4 or 1 per day (automatic) - prim forest site

radon flux < once per month (manual)

Soil Properties

soil temperature	bulk density
cont (primary forest site @ 5, 15, 35, 50, & 90 cm)	prev sampled @ km 83
soil moisture	N mineralization-net nitrification assays
cont (primary forest site @ 5, 15, 35, 50, & 90 cm)	4 per year (all manual TG points 7-day arobic incubation)
cont (pasture TG sites @ 2 depths)	soil C & nutrient stocks
cont (4 depths to 1 m @ km 83)	20 per season (prim forest site/2 soils)
throughfall	20 per season (logged & pasture sites)
2 weeks (@ prim forest site/2 soils)	ongoing (@ km 67 & 83)
2 weeks (@ km 83)	fine root production - monthly (sequen coring @ km 67 & 83)
fate of soil P - ongoing (km 83)	root exclus/decomp - ongoing (km 83)
element leaching - ongoing (km 83 @ 20 &100 cm)	fine root decomp - monthly (trench plots @ km 83)

Physiology

literfall	litter decomp
ongoing (km 67 & 83)	ongoing (km 67 & 83)
biweekly or monthly	litter bags
litter-floor-root C/15-N/nutrient stocks - ongoing (km 67 & 83)	microbial biomass C/N/P stocks - ongoing (km 83)

TG-04 - Radon-222 and stable carbon isotope tracing of carbon exchange and trace gas fluxes in old growth and selectively logged Amazonian forests

Site

Primary Forest (km 67) & Logged (83) Sites

Period

Oct-99 to Sep-02

Trace Gas Contentrations

VOC conc - campaign basis

Trace Gas Fluxes

CH_4 flux	radon flux - cont (prof @ 8 levs)
weekly to bi-weekly (manual)	
sporadic (isotopic comp)	

LC-06 - Validation and evaluation of MODIS data products in LBA

Site
Santarem Area
Period
Summer 2000
Measurements
Physiology
LU/LC
TM imagery

CD-05 The present and future effects of ground fires on forest carbon stocks, metabolism, hydrology, and economic value in Amazonia and Cerrado

Site
Primary Forest (km 67) & Logged (83) Sites
Period
May, Aug, Dec 1999 & 3-4 weeks in 2001 wet season
Measurements
Soil Properties

soil moisture - monthly (3 TDR inserts @ 12 m)	bulk density - once (to 12 m)
soil texture & structure - once (to 12 m)	soil water retention curves - once (to 12 m)

Physiology

leaf water potential - 2 weeks (both Yw & YL)	transpiration - 2 months (5 day), (only @ REPs)
stomatal conductance - 2 months (5 day), (only @ REPs)	photosynthesis - 2 months (5 day), (only @ REPs)
tree growth (dendrometers) - 2 months (tree stems/~1000 trees), (only @ REPs)	sapflow - cont, (only @ REPs)
literfall - 2 weeks	leaf N & P stocks - once, (only @ REPs)

LC-10 - Measurement and modeling of the inter-annual dynamics of deforestation and regrowth in the Brazilian Amazon: Land use control on the annual net flux of carbon

Site
SE Sector Santarém, Ruropolis, Uruará
Period
mid 80's to mid 90's
Measurements
Physiology
LU/LC
TM imagery

CD-07 - High resolution C exchange over large-scale Amazonia based on modeling and GOES satellite derived radiation inputs

Site
Santarem Area
Period
Mar-98 to Feb-00
Measurements
rainfall - cont (GOES)
Radiation

solar up and down - cont (GOES)	net (Q*) - cont (GOES)
infrared up and down - cont (GOES)	skin temperature - cont (GOES)
PAR up and down - cont (GOES)	

TG-08 - Trace gas fluxes associated with land-cover and land-use changes in the Brazilian Amazon Basin

Site
Primary Forest (km 67), Logged (83), & Pasture (67) Sites
Period
Oct-99 to Sep-02
Measurements
Trace Gas Contentrations
CO2 conc - dry & wet seasons (14-C portion of CO2 profs)
Trace Gas Fluxes
CO2 - flux dry downs (14-C portion of CO2 flux)
CH4 flux - sporadic (isotopic comp)
Soil Properties
soil C & nutrient stocks - ? (isotopes in soil, roots, leaves, org matter)
Physiology
tree census - long term (forest age based on 14-C conc in logged stumps @ km 67 & 83)

CD-09 - A modeling synthesis of the impacts of tropical forest conversion on carbon fluxes and storage, and on nutrient dynamics in Amazonia

Site
8 Primary Forest & 2 Pasture Sites
Period
Aug-Sep/99 (dry) & Mar-Apr/00 (wet) ? for future years
Measurements
Soil Properties
soil moisture - 2 samples (surface)
soil texture & structure - 2 samples
Physiology
LAI - 2 samples
leaf water potential - 2 samples
above ground biomass - 2 samples
leaf N & P stocks - 2 samples

tree census
once (forest size)
once (gap dist)
once (C in above-ground biomass)

CD-10 - Net ecosystem exchange of CO_2 and H_2O from primary tropical forest in central Amazonia

Site
Primary Forest Site (km 67)

Period
Oct-99 to Sep-02

Measurements

pressure - cont (surface)
wind speed
- cont (sonic @ 65 & 40 m)
- cont (anemom @ 65, 55, 35, & 25 m)

rainfall - cont (gap in clearing)
H2O mixing ratio - cont (dp hygrom @ 65 & 40 m)

air temp - cont (prof @ 8 levs)
wind dir
- cont (sonic @ 65 & 40 m)
- cont (vane @ 65 m)

ceilometer - occasionally

Radiation

solar up and down - cont (65 m)
infrared up and down - cont (65 m)
net (Q*) - cont (65 m)

PAR up - cont (65 m)
PAR down
- -cont (65 & 25 m)
- -cont (8 ground points)
- -cont (20 tree gap points)

Trace Gas Contentrations

CO2 conc
- cont (prof @ 8 levs)
- cont (0-65 m path)

CO conc
- cont (65 m)

Energy Flux

sensible heat (H) - cont (65 & 40 m)
latent heat (lE) - cont (65 & 40 m)
soil heat (G) - cont (2-5 cm)
momentum (3-axis Reynolds stresses) - cont (65 & 40 m)

Trace Gas Fluxes

CO2 flux - cont (65 & 40 m)

Soil Properties

soil temperature - cont (spatial & vertical dist - 16 sensors)

Physiology

tree growth (dendrometers) - monthly (~1000 trees)

3.4 RONDÔNIA SITE

ND-09 Biogeochemical dynamics in river corridors of the Amazon basin and their response to anthropogenic change

Site
Ji-Parana river basin
Main Sampling Stations:
Comemoração and Pimenta Bueno rivers at Vilhena
Comemoração, Pimenta Bueno and Ji-Paraná rivers at Pimenta Bueno
Ji-Paraná and Urupá rivers at Ji-Paraná
Jarú and Ji-Paraná rivers at confluence
Ji-Paraná river at Barragem
Ji-Paraná river at Tabajara
Ji-Paraná and Preto rivers at Calama
Additional sampling stations at tributaries of Ji-Parana, but with less detailed sampling
Periodicity of sampling at Main Stations:
4 times a year (low, rising, high and falling waters), each campaign lasting ~ 15 days in the years 2000, 2001 and 2002
Measurements
Discharge, Suspended Sediments, Major Ions, Nutrients, POC, DOC, O_2, CO_2, Methane, Elemental, isotopic and Molecular composition of organic matter, respiration rates, O-18 and D in water, isotopic composition of dissolved oxygen and carbon dioxide.
Logistical Needs
Car, boat, motor, small local lab for nutrient analysis at Ji-Paraná

ND-03 Linking soil biogeochemistry to surface water chemistry in small drainage basins of the Amazon.

Site
Fazenda Nova Vida (Ariquemes) and other streams in Jamarí and Ji-Paraná River basins.
Periodicity of sampling at Main Stations
1. September 1 – September 30, 1999
2. February 1 – March 1, 2000

Measurements
Water Chemistry: Anions and Cations - $N0_3$, NH_4, $P0_4$, TON, TOP, DOC, DON, DO ^{13}C, PO^{13}C, TSS, algae bioessays
Logistical Needs
vehicle in the field.
Laboratory: Deionized water source, small drying oven, balance (0.01 g), refrigerator, large chest freezer

ND-01 Land cover conversion in Amazonia, the role of environment and substrate composition in modifying nutrient cycling and forest regeneration.

Site
Ji-Parana and Porto Velho
Measurements:
One time sampling - particle size, bulk density, ECEC, $N0_3$, NH_4, P fractions (5-7), pH, exchangable cations, exchangable Al, organic carbon
Semi-annual sampling - $N0_3$, NH_4, resin extractable P
Logistical Needs:
Vehicle in the field

LC-10 - Measurement and modeling of the inter-annual dynamics of deforestation and regrowth in the Brazilian Amazon: Land use control on the annual net flux of carbon.

Site
Alto Paraíso (Ariquemes region)
Measurements:
Remote Sensing: Three vegetation classes TM – multitemporal analysis
Household Surveys: demographic farming system, household economy and technology
Peridiocity of Sampling:
July 18 – August 9, 1999
October 1999
July 1 – July 30, 2000
Logistic Needs:
Vehicle in the field
Accomodations in Porto Velho
GPS equipment

TG-08 Trace gas fluxes associated with land-cover and land-use changes in the Brazilian Amazon Basin

Site
Nova Vida
Periodicity of sampling at Main Stations

July 10 – August 5, 1999

Estimated: February 15, March 30, 2000
July 15 – August 31, 2000
Measurements
CO_2, N_2O, NO fluxes, Soil NH_4, NO_3, PO_4 pools, Soil moisture, Basic soil characteristics (pH, cations, texture)
All of the above under different plot-level manipulations
Logistical Needs
vehicle during field periods.
Laboratory: deionized water source, drying oven, benchtop, ~1 m^3, balance (0.01 g), refrigerator, chest freezer, spectrophotometer

LC-03 Radar remote sensing of landcover and biomass in the Amazon

Site
The whole Rondônia region
Periodicity of sampling at Main Stations
Late August – 1st or 2nd week of September, 1999
Measurements
Land-cover, above-ground biomass/ SAR-derived estimates
Logistical Needs
vehicle in the field.

Appendix 4.

LBA Data and Publication Policies

Approved by the LBA Science Steering Committee, May 13, 1998, Piracicaba, SP, Brazil

INTRODUCTION

LBA data polices are guided by the fundamental principle that cooperation and synergism should be maximized in all LBA activities. To ensure that all LBA participants have access to data in a timely manner and that appropriate credit is given to the Investigators, there is a strong need for a definition of data policies that will be adopted by the entire LBA.

LBA data policies will guide data sharing, citation of data from other, investigators access to restricted data and promote the exchange of quality controlled / quality assured data. All LBA researchers must follow the national laws concerning export of all data gathered by foreign researchers of the various Amazonian countries, notably Brazil. The LBA home page and the project offices in Brazil can provide this information.

LBA data and publication policies:

1. Data generated by LBA will become public domain and will be permanently archived in Brazil. The LBA Data Information System (DIS) will provide tools for documenting, storing, searching and distributing these data.

2. All LBA data should be available to all LBA researchers. Exceptions may be made in the case of raw or preliminary data, for which distribution can be restricted for a limited period of time.

3. There will be no periods of exclusive rights to publish LBA results. Exceptions are possible for students where graduation requirements prohibit publication of results prior to acceptance of a Thesis.

4. Individual investigators may make their own data more widely available at any time. Outside investigators may be given access to this data as soon as the data have been submitted to the LBA DIS, with some prudent time period for quality control.

5. Each LBA module is responsible for establishing a time schedule for data exchange within the projects and data delivery to LBA DIS. The time limit for data delivery to LBA-DIS will be no more than one year.

6. Data should be analyzed cooperatively by all scientists involved in obtaining them. Especially cooperation across disciplines and among South American, European and North American researchers should be encouraged. Publications resulting from work under LBA should be co-authored by all scientists who have participated substantially in the work, unless some participants choose not to be on the authors' list. The same applies to presentations at meetings. Special effort by each non-South American researcher should be put into integration of South American researchers in their work and in the publication of the results.

7. Where data are used for modeling or integrating studies, the scientist collecting the data will

be credited appropriately, either by co-authorship or by citation. Investigators using data provided by another investigator as a substantial component of a paper should offer the originating investigator co-authorship. In cases where data from other investigators are a minor contribution to a paper, the data should be referenced by a citation. Users of the data will always have to state the source of the data.

8. Specific constraints for certain data sources (e.g. satellite products, global meteorological analysis, etc) may be subject to copyright restrictions which are more limiting than this LBA data policy. It is up to the LBA-OIC to take the first steps in making contacts with officials and institutions in order to prepare specific agreements that will allow LBA scientists to use the data.

9. If conflicts do occurs, they should be resolved at the level of the LBA modules.

Appendix 5. Attendees - LBA-Ecology Third Science Team Meeting, 19 - 21 April 1999

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